Dr. Hughes Bennett
Edinburgh
Scotland

With respects of
The Author

ON THE
DYNAMICS, PRINCIPLES
AND
PHILOSOPHY
OF
ORGANIC LIFE:

AN EFFORT TO OBTAIN DEFINITE CONCEPTIONS OF

HOW DO MEDICINES PRODUCE THEIR EFFECTS?

Valedictory Address, delivered to the Muskingum County Medical Society, at its Annual Meeting, held in the City of Zanesville, Ohio, May 6th, 1868.

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TO MY FELLOW MEMBERS

OF THE

Muskingum County, Ohio, Medical Society,

Who have so repeatedly shown their confidence in, and honored me by, selecting me as their chief presiding officer—and the Society itself as the pet and pride of my professional life—and because of the scholarly and professional attainments of its membership, and the dignity, harmony and ability which have characterized its more than half a hundred sessions—and to all who have contributed any of the facts and principles upon which the conclusions of this essay are based—and to the friends of medical progress, wherever medicine is cultivated as a science, these pages are most respectfully and cordially inscribed by the author.

Z. C. McELROY, M. D.

Zanesville, Ohio, December 10, 1868.

The most difficult part of it was the hystogeny and hystolysis of the tissues. That overcome, by its analogy to crystallization in the inorganic world, the remainder was as clear to me as sunlight. When the essay was completed, the impression that I had made a valuable generalization continually deepened.

After its delivery, one of the members of the Medical Society, every way competent to criticise it, said that he had no doubt of the truth of the principles of the essay, as they were not new to him, but were so far in advance of the age that it was barely possible the grandchildren of the present race of practitioners might be guided by them in practice. That it would be necessary to create a new medical literature, reinterpreting the empirical facts of disease and therapeutics, and that that would consume at least half a century. I am conscious that I have gained one-half or three-fourths of that time already; for I am entirely guided by them now in practice, and with an amount of satisfaction and certainty to which I was before an entire stranger. Anxious to obtain further criticism, brief synopsis of the essay were made and sent to various distinguished practitioners and teachers. An incident, not needful to detail, brought it before one of the most distinguished authors and teachers of the country, who advised its early publication; and, I may say that each day's experience and professional reading serves to confirm my own convictions of the value and importance of its philosophy and generalizations.

The following quotations are introduced as prefatory to the inquiries which I propose to make on the subject:

"Since it is given to us to know our own existence, and be conscious of our own individuality, we may rest assured that we have what in reality is a far less wonderful power—the capacity of comprehending all the conditions of our life. God has framed our understanding to grasp all these things. For my own part, I have no sympathy with those who say of this or that physiological problem, it is above our reason. My faith in the power of the intellect of man is profound. Far from supposing that there are many things in the structure and functions of the body which we can never comprehend, I believe there is nothing in it we shall not at last explain. Then, and not till then, will man be a perfect monument of the wisdom and power of his Maker, a created being, knowing his own existence, and capable of explaining it. In the application of exact science to physiology, I look for the rise of that great and noble practice of medicine, which, in a future age, will rival in precision the mechanical engineering of my own time. Even now this method is attended with results which must commend it to every thoughtful mind, since it is connecting itself with these great truths which concern the human family most closely, and is bringing into the region of physical demonstration the existence and immortality of the soul of man, and furnishing conspicuous illustrations of the attributes of God."—*Draper's Physiology, pp.* 25–6.

"I am very sensible of the great honor you have done me in electing me the first President of the Clinical Society. Reluctant, as I not unnaturally am, to assume, at my time of life, any fresh duties or obligations, I yet must confess that I have extreme satisfaction and pleasure in accepting at your hands this new office; for the society which we are founding to-night seems to me well calculated gradually to bring about that which, in my judgment, is the thing most needful, at present, among us. I mean more exactness of knowledge, and, therefore, more direct and intelligent purpose, and more successful aim, in what is really the end and object of all our labors—the application of remedies for the cure or relief of diseases. *Certainly the greatest gap in the science of medicine is to be found in its final and supreme stage—the stage of therapeutics.* Its material pathology, also, under the auspices of a sister society, has been, I will not say completely, yet very amply and fruitfully ransacked by the diligent scrutiny and study of the dismal, but instructive, revelations of the dead house. *I say its material* pathology, for the condition of doctrinal pathology must necessarily partake of whatever imperfection may be found in the correlative science of physiology. Again, we have attained to a great degree of certainty in the detection of disease in the living body. We know tolerably well *what* it is we have to deal with; but we do not know so well, *nor anything like so well, how* to deal with it. This is more true, no doubt, in the province of the physician, than in that of the surgeon; but it is lamentably true in both provinces. We want to learn distinctly what is the action of drugs, and other outward influences, upon the bodily organs and functions—*for every one now-a-days, I suppose, acknowledges that it is only by controlling or directing the natural forces of the body, that we can reasonably hope to govern or guide its diseased conditions.* To me it has been a life-long wonder how vaguely, how ignorantly, how rashly, drugs are often prescribed. We try this, and not succeeding, we try that; and, baffled again, we try something else; and it is fortunate if we do no harm in these our tryings. Of this the evidence is plentiful and constant. * * * * Still, of therapeutics as a trustworthy science, it is certain we have as yet only the expectation. The influence of drugs upon bodily conditions of health and disease is most real and most precious to us. And some of them, in our contests with disease, we have learned to wield with much confidence and success. No one questions the marvelous power of quinine to stop malarious fevers and other periodical complaints. Who can doubt the efficacy of opium or anæsthetic vapors in blunting the sensibilities of the body, and so quelling pain? Or of the iodide of potassium to eliminate from the body, apparently by first dissolving them, certain poisonous elements? The rough, yet sanative, effects of emetic and purgative drugs are notorious to all. But there is a host of other known or reputed remedial substances—to say nothing of a further host, no doubt, hitherto unthought of and unessayed, about which our practical knowledge is very imperfect, or even misleading · * * * —peradventure, to the discovery even of the laws—by which our practice should be guided, and so bring up the therapeutic and crowning department of medicine to a nearer level with those parts which are strictly ministerial and subservient to this."—*Sir Thomas Watson. London Lancet, Am. Ed., April,* 1868.

"The true principles, therefore, which should guide our efforts to advance therapeutics are—

"1st. That an empirical treatment, derived from blind authority, and an expectant treatment in an equally blind faith in nature, are both wrong.

"2d. That a knowledge of physiology and pathology is the real foundation and necessary introduction to a correct study of therapeutics.

"3d. That a true experience can only have for its proper aim the determination of how far the laws evolved during the advance of these sciences (physiology, pathology and therapeuties) can be made available for the cure of diseases.

* * * "I have only to express my conviction that our uncertainties as to the future existence of a scientific medicine can only be removed by working out; in all its details, the molecular theory of organization. The histogenic and histolytic transformations of the tissues, the various metamorphoses they undergo in the exercise of the nutritive and nervous functions, as well as the correlation and conservation of the dynamical, chemical and vital forces of the economy, are the points now being determined by the physiologist. We are still waiting for the solution, by the organic chemist, of several inquiries necessary for our onward progress. But these accomplished, as it is hoped they soon will be, it must be recognized that all action and all function must be essentially dependant on the formation and existence of the molecular constituents of the frame. Then it will be seen, also, that the agents which operate on it, either

from without or within, must be so capable of being prepared as to act upon these minute particles, and it will be made apparent that one law will blend into a harmonious whole the kindred sciences of physiology, pathology and therapeutics."—*John Hughes Bennett,* 1864, *in London Lancet, Am. Ed., March.*

HOW DO MEDICINES PRODUCE THEIR EFFECTS?

The modus operandi of medicines, or how do they produce their effects, are inquiries which have been awaiting solution for many centuries. A great many answers have been given, some of them true as far as they go, but none that have satisfied or commanded the assent of the medico-philosophical world at any time. Standard authors tell us that some are absorbed into the circulation, some act chemically, some mechanically, some by sympathy, in each case having some sort of elective affinity among the organs and textures, and at these elected places producing their effects. After studying the best resumes of what has been written on the subject, the inquiry still presses on the unsatisfied mind, "How do they operate?"

The mass of facts in regard to their visible effects have been accumulating from a period ante-dating our present chronology; but they have been simply empirical facts and observations, without a philosophical solution of their relations to the living organism. Classifications of therapeutic agents have long existed, some of them minute and elaborate, but all based on those parts of the system at which their effects become visible and tangible to our senses. Thus: if an article produces alvine discharges, it is classed as a cathartic; if vomiting, an emetic, &c., &c. Some of them have to be placed in two or more classes, because different degrees of effects are visible, according to the dose and mode of administration, at one or more organs, or on one or more tissues.

This method of classification is purely physical, and based, for the most part, on an increase or diminution of some natural or unnatural discharge from the body. The idea of a cathartic is indellibly associated in the mind, by education, with the somino or water-closet. So an emetic, with the throes of vomiting, and the ill-looking stuff ejected from the stomach. Again, some are classed as stimulants, and the physical idea associated with their action is, "quick diffusion and transient increase of vital energy in the heart and arteries, and brain and nerves." In the progress of this investigation an attempt will be made to show that, with this nomenclature, classification, and their mental associations, it is impossible to get at their modus operandi. In fact, the first step toward getting a solution to the inquiry, at all in agreement with the processes of life, is to banish from the mind the existing classifications of the materia medica, based on their visible effects; but not of their effects, for these are all important; so that the mind may be free to arrange and classify as the organic processes of life may suggest. It would not be possible, at present, to make a classification of the effects of medicines, in agreement with the organic processes of life, without the mass of empirical facts in therapeutics now existing in our literature. What is wanting is not new facts and observations, but a philosophical grouping or classification of those already in existence, and a reinterpretation of them, and the future study of therapeutics in accordance with their influence on the organic processes of life. This does not, as it appears to the writer, exist in our medical literature now. Having arrived at a satisfactory classification, to my own mind, and finding that in my hands it combines greater simplicity, uniformity and certainty in the art of prescribing medicines than that it displaces, it is my present purpose to submit it to the society for criticism, adoption or rejection, as the proofs submitted may influence judgments for or against it.

The practical application of the science and art of medicine has not kept pace with the development of its collateral branches of chemistry, physiology, histology and anatomy. The most striking changes are due to the greater reliance on hygienic and dietetic measures, and less on medicines, in the treatment of disease. The number of medicines in daily use by the most successful practitioners, has undergone a striking diminution. Prof. Gross, in a recently published paper, states, that out of the many hundred different articles required to be kept in well appointed drug stores, not above thirty-five to fifty are in common and daily use by physicians of the largest practice. These are significant facts, and believed to point to that great event to which the general medical mind is tending, viz: the reduction to order and symmetry of the vast accumulation of therapeutical facts in medical literature.

Existing classifications tend to associate in the medical mind certain more obvious symptoms, or a disease by name, with certain remedial agencies. Thus, a late and valuable work on materia medica and therapeutics, gives an index of diseases by name, and their remedies. With such clogs as this, is it any wonder that practical medicine lags behind its collateral branches in development? The first step toward a scientific and philosophic and, perhaps, natural grouping of therapeutic agents, as they affect the organic processes of life, is to agree upon, and adopt, some common yet definite idea of these processes—what are they, and in what do they consist? Every organized being presents to us one prominent fact—that it must have food—the materials out of which its body is to be formed and sustained. This embodies the idea of nutrition. It is a fact that the living body is daily and momentarily building up and breaking down. Human beings, under our civilization, as a rule, eat three, more or less, hearty meals of organized food every day in health; more food being required by those who perform hard bodily, or close mental labor, than those who spend their time in idleness, or without work of any kind. What becomes of it? Some of it is certainly assimilated to the body; another part, possibly broken down in organization, to furnish dynamics for a higher organization of the remainder; while the various tissues and textures are as certainly and constantly, asleep or awake, undergoing the same process of reduction in organization, some portions being passed out of the body in a low organic state, while other portions find exit in the ordinary forms of inorganic matter, as carbonic acid and water. This process of reduction of organic tissues is known as oxidation; because the free oxygen taken in at the lungs plays a conspicuous part in breaking down the complex organization of tissues.

We have, then, as the two leading processes of organic life *nutrition* and *oxidation ;* and as the continuance of life in every individual case depends upon their integrity and natural relations to each other, it is with reference to how medicines influence them, that therapeutic facts are to be grouped and classified, and from studying these, that we can arrive at a correct solution to the inquiry, "How do medicines produce their effects ?"

Having thus settled on substantial bases the facts of nutrition and oxidation, the next step is to fix upon some definite conception of disease, not by name, but by the facts, as they pass under our observation.

Prof. Gross, in the recently published paper already referred to, gives the following definition of disease:

"Disease is not, as it was formerly imagined to be, a special entity, a particular essence, a something vague, intangible, mysterious, but simply a departure from the normal standard; a change in, or of, a part, brought about by a perverted action of its circulation, innervation and nutrition, and modified by structure and function. Nearly every disease, whatever its name or site, is essentially an inflammation. Even in what are called the neurosis, or nervous affections, inflammation generally plays a conspicuous part."

He then goes on to say: "These two propositions—i. e., that disease is a modification of nutrition, and influenced by structure and function—thus briefly stated, comprise the germs of"—in the printed copy from which this quotation is taken, the word revelation is used, but it is perhaps a typographical error for revolution—it will then read: "These two propositions, thus briefly stated, comprise the germs of a revolution which has swept away the whole system of nosology (entity of disease), and has done more than all that preceded it in laying its foundations (practical medicine) broad and deep as a grand science, to be viewed and studied as an object of natural history, in the same manner and upon the same principles precisely as an animal, a plant, or a mineral is viewed and studied, apart from all hypothesis and speculation, as something tangible and existent, not vague and undefined, without form or substance."

Still further it is stated: "The fact that nature is often capable of curing disease, is now universally admitted. This is not, as has been stated, new; but for the diffusion of a more general knowledge of it, the world is mainly indebted to two men, Sir John Forbes, of London, and Jacob Bigelow, of Boston. That every case of disease, whatever its origin, location, or symptoms or complications, should be treated on its own merits, or according to the peculiar features by which it is characterized, must be evident at first sight; but, unfortunately, this principle is seldom recognized at the bedside, and the consequences, as may well be imagined, are most pernicious. The universal employment of this or that treatment, in consonance with the fashion of the day, can not be too pointedly condemned."

In the spirit indicated by Prof. Gross, it is proposed in this paper to investigate the modus operandi of medicine, as any other object of natural history or philosophy is studied, and not as something vague, mysterious, intangible, and not understandable, but as something that has an existence, and can be studied and understood.

As an example of the other way of studying the modus operandi of medicines, take the following extract from the foreign correspondence of a leading medical journal of Philadelphia, purporting to have been written in Paris, France, in the year 1867, and if so, possibly by an American physician or medical student, temporarily in that city. The letter is dated 10th November, 1867, and gives an account of the treatment of acute rheumatism by the sulphate of quinia in the Paris hospitals, with the following explanation of its modus operandi:

"The theory of the action of the sulphate of quinia is based on its influence on the nervous system. It is supposed to shock the nerves, as in intermittent fever, and, by stimulating them, arrest the process of disassimilation, which proceeds, perhaps, with such rapidity because the usual influx of nervous force has been withdrawn."

Making every possible allowance for clerical and typographical errors in this expose of medical dynamics, it is, in any event, simply nonsense. It may well awaken amazement that such a statement of the modus operandi of any medicine should be written in Paris, in the full blaze of medical light believed to shine therein in the year 1867, by an American physician or medical student! It may be an extreme case, and an extreme blunder, but it serves to show the necessity for more and better philosophy in regard to the mode of operation of medicines, if only for the sake of simplicity and certainty in their administration.

The idea of the classification of medicines to be submitted in this paper, and it was but an idea, was probably suggested by some lectures by H. Bence Jones, published in Braithwaite, and Chambers' works on Digestion and its Derangement, and Renewal of Life; and, possibly, by Bennett's Clinical Lectures. Other sources it is difficult to specify. But the mode of operation was suggested by observing the effects of morphia by the hypodermic syringe. These ideas were elaborated in the writer's mind to present proportions, guided by the modern philosophy of the continuity of matter and force. The known facts of anatomy, physiology, chemistry, histology and therapeutics, are made use of as the substantial basis for certain inductions.

Medicines, then, as they influence the leading organic process of life, are classified as follows:

PROMOTERS AND RETARDERS

of	of
Nutrition	Oxidation
or	or
Constructive Metamorphosis.	Destructive Metamorphosis.

This tabulation combines scientific exactness of classification, and, as in chemistry, the classification of itself explaining how each therapeutic agent or measure produces its effects.

These are the two great classes, each subdivided into two other classes. The organic processes of nutrition and oxidation have, no doubt, modifications in regard to time, and the character of the organic matter undergoing the process of assimilation or oxidation; or, in other words, constructive or destructive metamorphosis. The nutrition, for example, of the medalla oblongata would be, very probably, different from that of the gastrocnemei muscles; and, if true in this instance, would be true, also, with reference to other and dissimilar tissues. They each have their mode, or rate, and time, of nutrition and oxidation; and must, also, be differently influenced by different agents of the materia medica, or by the same agents. As a refinement, the class of promoters of assimilation may be subdivided just so many times as there are widely different textures to be influenced; but, for practical purposes, this need not be very minute. So, also, the retarders of assimilation may be subdivided in the same way. The promoters and retarders of oxidation, or destructive metamorphosis, may be, in like manner, sub-divided. The great fact to be constantly borne in mind is, however, that the effects of all the four leading classes, or any subdivisions that may be made, are universal over the system, in some parts more than others, but all parts sooner or later brought under their influence. There are no therapeutical agents having only local effects.

In studying the human body, anatomically, physiologically and philosophically, it is found that amidst its complex organizations, functions, and ends accomplished, there is nothing left to chance, but that material instrumentalities are found, through and by which each dynamic result is attained. The reign of law is supreme among its organs, structures and functions. Though momentarily dissolving and reconstructing, the types, in health, are ever preserved. The dynamics of the human body are under the control of this force of individuality, or the strictly vital force, as contra-distinguished from the organizing force. The organizing force reproduces the material organization; the vital produces the types or forms.

Modern scientific investigation has established the identity of many of the chemico-vital phenomena of the living body, with the ordinary chemical phenomena of physical science out of it. Thus, organic chemistry, says the London *Chemical News*, has constructed a large number of organic compounds from carbonic acid, water and ammonia, and some from the elements themselves. The oils and fats have been formed—sugar almost within reach—but the albuminous still away beyond its present achievements. Of the descending compounds, identical with these, the results of the retrograde metamorphosis of the human tissues, almost all can be reproduced at will, out of the body. These facts make it possible to arrive at a proximate and understandable solution to the question, "How do medicines produce their effects?" even though failing to demonstrate some conclusions partly arrived at by analogy. The correlation, or mutual conversion of the physical and vital forces, is accepted by the scientific world, though the demonstrations are less clear than the conversion of the physical forces alone.

The evidence, however, that medicines can produce no other effects than modifications of the organic processes of life, is clear and conclusive to my own mind, though a failure might be made in endeavoring to satisfy others in the same way and to the same extent as myself. But as the reign of law is supreme, and we can have no perceptions of any force, only as the effect of some pre-existing force, it follows that the dynamics of life are all dependent on the oxidation of organic matter or tissues. The forces manifested by therapegtic agents can be evolved only as they modify the processes of constructive or destructive metamorphosis, or the organic processes of life, nutrition and oxidation.

In grouping the component parts of a human body for the purposes of study, as any other object of natural history, one of the most striking features is its dual life; one, that of conservation, or nutrition—involuntary; the other, that of relaxation to other objects—voluntary. The action of the stomach and bowels, heart, lungs, and the motor power of each, are either imperfectly, or not at all, under the control of volition or the will. Sight, hearing, moving from place to place, &c., are voluntary, or under the control of volition.

Another remarkable feature is, that the life of relations is intermittent, cannot be maintained in a state of activity more than two-thirds or three-fourths of the time; the remaining part is passed in what is known as sleep, a state of more or less complete suspension. It is during this suspension or sleep, that the capacity or power of sustaining the period of activity is accumulated. On the contrary, the life of conservation has remissions only, never wholly suspended. Again, the component parts of the human body may be grouped, for purposes of dynamic study, into the producers, transmitters and consumers of dynamic force. In the first group, or producers of force, are included the large and two smaller brains, their continuation as the spinal chord, and various masses of similar tissue, called ganglions and plexuses. In all of these we find two dissimilar tissues, the gray and white, conditions corresponding to, and requisite for, the evolution of dynamic force in ordinary physics. The evolution of force is coincident with oxidation of these dissimilar tissues, whether in the brain, chord, ganglionic or plexual masses. The transmitters, or carriers, of dynamic force, are chords of complex character, containing within the same sheath separate fibres for the transmission of dynamic force for several distinct ends, as motion and sensation, going out from the central masses, and from the exterior back to the interior. The consumers of dynamic force are the muscles, organs, and nerve masses themselves, for they, too, must be constantly renewed, probably most largely during sleep.

To these elements, grouped in the several ways stated, must be added the blood—the fluid stream—into which are poured alike the organic materials for the conservation of the body, and the debris of the momentarily dissolving tissues of which it is composed. From this stream the several organs take the materials with which to perform their allotted offices of conservation, mixed conservation and elimination, or elimination alone. All of the organic instruments of the body may be grouped into these three classes, though they perform but the two offices of assimilation and elimination. Some of them, only one, as the stomach and bowels, or, perhaps, more properly, the whole alimentary track—assimilation only—though the lower bowel is the receptacle of effete matter in part, awaiting convenience in ejecting it. Others, as the kidneys, elimination only; while others, again, perform parts of both acts, as the liver and lungs. That is the human body as grouped for present study—wonderfully complex in detail, and as equally wonderfully simple when viewed in its two great aspects of nutrition and oxidation; for, however apparently diverse its component parts, they naturally arrange themselves in one or the other classes of assimilants and oxidants. The present object is to obtain a solution to the inquiry, "How do medicines produce their effects?"

It has been shown that for every dynamic end in the human body, material instrumentalities are found; therefore, among these instrumentalities must be sought the solution to our present inquiry. A necessary step to further progress in this investigation is, the formation of some more or less definite conception of organic nutrition and oxidation. Here resort must be made to analogy, not always a safe way of reasoning, but, in the present instance, not likely to lead far astray. It may be accepted as established truth, that these transformations of the food consumed by human beings, into the types and forms of their various organs and tissues, as well as their retrocession to lower states of organization, is among the molecules or atomic particles of matter; that it is, also, through the medium of cells, or minute organisms, formed in and nourished by the blood itself, that the solid tissues and textures of the body are formed; that these cells become the various solids of the body, in the smaller ramifications of the blood vessels; that these solids, in their turn, are oxidized, and passed out of the body, either as organic matter, as carbonic acid and water, or organic matter, of lower organization, and not organizable again, except by vegetable organisms; for living, organized beings can only be nourished by organic matter, organized from inorganic elements, by vegetable organization. The first acts of the digestive or assimilative process is reduction of all food to a uniform solution. The simplest idea of animal growth or nutrition, is that of crystallization. In the inorganic world, each substance capable of liquefaction by solvents or heat, has its own definite crystalline forms, which are always assumed when passing from the liquid to the solid state, unless interfered with by extraneous circumstances, as variations of temperature, presence of heterogeneous matter, &c.; and here is a key which will unlock some of the secrets needful to be revealed in answering the present inquiry, viz: the presence of disturbing elements in passing from the liquid, or fluid state, to solid states or forms. The formation of ice by the crystalization of water can be looked at with our eyes, supplemented by powerful optical instruments; but while we see the results of the process, and know that only certain elements are present, we fail to get at the ultimatum; but we know the fact, demonstrated again and again, that a liquid has passed into the solid state; and, in doing so, it has assumed a crystalline form. Under some circumstances, the passing of the liquid blood, or liquor sanguiness, into solid tissue or crystalline forms, is to be witnessed by the histogenist in the web of the frog's foot. So much, fact and analogy teach in regard to nutrition, and organic tissue making or histogeny. The recent microscopical-histological researches of Beale strikingly confirms the idea that organic tissue making conforms very closely to the process of crystallization in the inorganic world.

All complex organizations tend inherently to separate into lower states, or forms of organization, and can only be restrained or retarded in this process by certain conditions, as the preservation of flesh by chloride of sodium, carbolic acid, arsenic, corrosive sublimate, low temperatures, &c. In the living body, surrounded by all the conditions requisite to speedy retrocession to lower or less complex states of its highly organized tissues, the dynamic force, liberated in the act oxidation, is the force, in the main, by which life is conserved; and as these lower forms of organization, or effete matter, the result of the destructive metamorphosis of the tissues of the living body have been successfully formed by chemistry out of the body, the processes or means by which they are produced, both in and out of the body, can not be very widely different. To those who have followed closely the grouping of these elements, it is hoped that, with myself, they can see that we stand in the immediate presence of the solution of the inquiry, "How do medicines produce their effects?" Can it be otherwise than as they modify, promote or retard the passing into crystalline, or solid forms, of the liquor sanguiness, into the various tissues and textures, or as they promote, retard or modify the process of retrocession into lower grades of organization of some, or all, of the constituents of the blood, or tissues themselves?

After so much, recognized and understood, there is still a further mystery, but no greater than that of the conversion of water into ice before our vision.

The cerebrum, cerebellum, medulla oblongata, spinal chord, ganglionic or plexual masses, grouped together, form the equivalents of electro-magnetism of physical science, and are to be studied as centers of the dynamics of the system, controlling alike nutrition and oxidation, not only of the remaining tissues and organs of the body, but of themselves. The gray, or cineritious, matter has the highest and most complex organization; the medullary, or white, is widely different in physical appearance, as well as structure, organization and function. The circulation through the brain proper is peculiar, the venous blood being concentrated in sinuses of large capacity, and the circulation is proportionately large in all of the nervous masses. From analogy, these form the equivalents of the electro-magnet of physics, having two dissimilar tissues, with a fluid, to furnish the conditions and means of liberating dynamic force. The analogy between the wonderful net work of telegraph wires, traversing every part of the civilized world, bringing its most distant part into almost instantaneous communication, and the human nervous system, has long been, to me, a subject of profound interest. Since this investigation has been commenced, a telegraph office has been visited, where a main battery for a short line was kindly shown to me by the manager. It was composed of a number of Grove's cells. Each cell consisted of a clear glass cup, in shape like a mammoth tumbler, holding about a quart of a clear solution of acid and water. In this acid-water was placed a plain cylinder of zinc and quick silver amalgam, as clean and bright as a mirror. Inside the metal cylinder there was a white, porous porcelain cup, holding a strong acid. A thin slip of platinum hung in this strong acid, suspended from a copper arch, which connected this cell with an adjoining cell, and in this way the whole of the cells composing the battery were connected. From the last cell a wire proceeded to the earth, outside the building; from the first in the series, another wire proceeded to the operator's table. The acid-water furnished the oxygen; the zinc amalgam the material to be oxidized, and the only appearance that indicated the working of the battery, was the small globules of hydrogen escaping, as the dynamic force was liberated, which could flash a message to the other end of the line in far less time than has been consumed in describing it. The analogy between it and the human brain is almost complete. The exterior case, the complex materials, fluid and solid, and the oxidation coincident with the liberation of dynamic force! At the operator's table it was found that a local battery was needful to obtain sound—the language of the telegraph—corresponding with a ganglionic mass in the human body. It was, also, ascertained that on long lines, it was at times necessary to have a smaller battery, or repeater, in the main circuit, in order to secure satisfactory working. To complete the analogy, as it were, the very batteries require food—nutrition; they work about a week on this short line, and then require a renewal of their acid-fluid parts, and, at longer intervals, their solid parts, to keep them in working order. It is, also, needful to remove the effete matter, resulting from the molecular metamorphosis, or oxidation, a necessary condition of dynamic integrity. Let the operator touch the key at the receiving and transmitting table, complete the circuit, and in an inappreciable time, the impulse is made manifest at a similar instrument, in the hands of another operator, speaking in an audible voice, a strange language to the uninitiated, plainly heard by the operator, or any others near by; and this hundreds, it may be thousands, of miles away! Truly a most striking resemblance to the human brain and nerves.

The processes and results of photography, bear a most striking resemblance to the ends accomplished in the human eye. A dark chamber in the eye, same in the camera; a crystalline lens in the eye, the same in the camera; an expanding and contracting pupil in the eye, its equivalent, by perforated diaphrams, in the camera; an inverted image in the eye, the same in the camera. Could any resemblance be more perfect?

But the points of resemblance between the unorganized telegraph and the human nervous system extend still further. The human being in comatose or insensible conditions, the remainder of the body, as it were, cut off from its connection with the brain, still performs, more or less perfectly, the organic acts of life; so the telagraph worked very satisfactorily, for an hour or more, on an occasion some time since, cut off entirely from the main battery. This was coincident with unusually brilliant displays of the aurora borealis. During the prevalence of violent movements in the physical forces, the telegraph becomes unmanageable, and even dangerous, corresponding with mania and convulsions in the human being. In bad weather it works slowly and hesitatingly, not quick and sharp as in fine settled weather. These analogies might be almost indefinitely extended; but sufficient has been stated for present purposes.

Striking as are the resemblances, there is still wanting the individuality of life. Were it not that we are studying how medicines produce their effects, as we would study any other object of natural history, as something tangible, and having an existence, rather than as a vague, mysterions, intangible something else, our investigation would here terminate. The forces in telegraphy and the dynamics of human life are correlated; therefore, we are warranted in pushing our ivestigation to the utmost limit, in order to get the best possible understanding of how medicines produce their effects on the organized system under the influence of life, as having a tangible and understandable existence.

Before proceeding to apply these general facts and analogies to the elucidation of the present inquiry, a brief recapitulation of them will aid in bringing them orderly before the mind, that their application may be more perfectly understood. It has been shown, then, that the two leading processes in the organic life of a human being, the object of present study, are its nutrition and waste, or its assimilation of organized food to its types and forms, and its reduction of the organic materials of these types and forms back to lower grades of organization, or inorganic states of its elementary constituents, spoken of in this investigation as constructive and destructive metamorphosis; that these processes occur among the atomic particles of matter; that these processes are by a series of gradual ascents in the scale of organization, at each stage of which new compounds are formed, until the highest point is reached, as in albumen and fibrin, when it is in a suitable condition to be assimilated, by means of minute cell organizations, to the types and forms of the various organs and tissues, in a manner strikingly analagous to crystallization in inorganic nature; that the retrocession of these elements, from their complex and highest organized states, are by the same gradual processes as was observed in their ascension, forming many new compounds of lower organization and states, as urea, lithic and uric acids, and their compounds; in which states some portions are passed out of the body, while others are reduced to their lowest inorganic states, as carbonic acid and water, but none of the retrograde compounds ever assume the same states as the ascending; that some of these ascending and descending compounds had been successfully formed out of the body, and that the processes, in or out of the body, could not be widely different; that as organization was ascending power or force, was conserved, or consumed, to be liberated again during the retrocession to lower grades of organization; that the dynamics of life were due to destructive metamorphosis of the tissues of the body mainly, though possibly not wholly, for some portions of organic food may be reduced in organization, to furnish power for other portions ascending into higher or more complex states; that these gradations are necesssary to secure the ends of life: for, if the retrocession was accomplished at one step, it would be equivalent to the assumption of the gaseous form by the solid particles, composing what is called gunpowder; that though these processes are known to occur, because the facts are accomplished every moment in our own bodies, we can only form conceptions of how they occur by studying the more elementary changes in matter and force in the inorganic world; that the first process of nutrition is to reduce organizable matter or food to the fluid form; that out of this fluid was formed, by means of minute cell organizations, the various organs and textures of the body; that the most elementary metamorphosis of a fluid to the solid form was found in that of water passing into the solid state of ice; that this was accomplished by the atoms of water arranging themselves in the crystalline form; that it was a uniform law in the inorganic world that the crystalline state was assumed whenever a fluid passed into the solid state from solutions or liquefactions, by heat or other means; that the process of crystalization was subject to important changes, by sudden variations of temperature, presence of heterogeneous matter, and other circumstances, greatly modifying the resulting crystalline product; that the final act of nutrition of the different textures of the body, was the passage of organizable food or matter, from the liquid state to the types and forms of its different organs and tissues; that thus, and thus only, by studying the changes of matter and force in their more elementary combinations, could a definite conception be formed of organic tissue making or histogeny; that for every dynamic result observable in the human body, a material instrumentality is found; that the reign of law is supreme in all its parts, and that nothing is left to chance; that in arranging for study the elementary parts of the human body, having reference to its dynamics, it was found to have a dual life, conservation and relation; that the life of conservation was remittent, while that of relation was wholly intermittent; that during the intermission, power, or dynamic force was accumulated, or the conditions requisite for its liberation were obtained, for the period of activity; that the period of intermission was in the ratio of ¼ to ⅓ of the whole time, and must be interposed at short intervals; that for dynamic study the elements of the body were grouped into power producers, the nerve masses, small and large; power transmitters, the nerve chords; power consumers, the whole organism; that to obtain some definite conception of the complex dynamics of life, it was necessary to study force in some of its more elementary states; that the electro magnetic telegraph was selected for that purpose; that a most striking analogy was found to exist between its elementary parts and dynamic results with those of the human body; that there was the main battery, corresponding to the brain, a local battery was necessary wherever signals were to be taken, to speak its language, corresponding to ganglionic and plexual masses, which are found in the body wherever a function is to be performed, or an organ presided over, to supplement, as it were, the main battery, or nervous mass, and render the functions to be performed somewhat independent of the central mass; that it had wires connecting distant places, multiple wires for communicating both ways at the same time, being suspended on the same poles, corresponding to the nerve chords, containing afferent and efferent fibres; that the dynamics of the telegraph were obtained by the reaction between the atoms of inorganic matter; that the metals in the batteries had to undergo processes of smelting and refining from ores, to fit them for their allotted uses, a compensation for organization; that it was during the combinations of the atoms of metal with the atoms of oxygen, or a return of the metals and fluids to their states in nature, that the forces of electro-magnetism was made available for the transmission of impressions from one place to another, almost irrespective of distance; and, finally, that it had its freaks and curiosities, and abnormal workings, as was the case with the human nervous system; that it was, also, necessary to form a definite idea or conception of disease. Professor Gross' definition was, that it was not a special entity, but a departure from the natural condition of health, brought about by a change of the nutrition or oxidation of a part or the whole of the body, and modified by structure and function; that Professor Gross' definition is used only because of its precision, and not because it is not a reflex of the views of disease by the advanced medical mind of the age, for, in the very nature of things, it can not be anything else than a departure from the normal processes of repair, or renewal and waste; that the classification of the articles of the materia medica, now taught in schools, and contained in text books, based on these parts of the system only at which their effects become cognizable by our senses, was a bar to their philosophical grouping, which should have for its basis the organic acts of nutrition and oxidation.

With these facts and analogies alone to guide us, a very intelligent conception may be formed of "How do medicines produce their effects;" but to them must be added the known effects following impressions on the special senses. How does light produce vision? In no other possible way than by chemical changes in the nerve tissue spread out on its interior; and these chemical changes are oxidations, precisely as on the sensitive surface in the camera in photography. No dynamic results ever occur, only as organic matter is retrograding to lower forms of organization, or complex organic compounds retroceding to more elementary states. Gunpowder requires the presence of charcoal—carbon—to make it explosive. Gun cotton and nitro-glycerine, and dynamid (the new explosive compound), owing to more complex organization, are far more powerfully explosive compounds; still, in every instance, the dynamics are due to oxidation.

If there were no oxidations, there would be no vision; or if vision, the eye would never tire or grow weary—would, in fact, be a mere reflecting surface, as a mirror. Yet the weariness of the eye is a well known fact to all who have vision. Nor are the impressions made on the eye instantaneous. An appreciable time is required to make such changes in the nerve structure as to enable the central nerve mass to perceive images. Looking from the window of a rail car in rapid motion, no distinct images are formed of near objects coming into and passing rapidly out of the field of vision. So, interrupted light, as in walking past a paling fence, with the sun shining through it, prevents distinct vision, and soon produces weariness and actual pain in the eye. So, again, looking at regular bars or cross bars, or stripes and checks, uniform in size and colors, is painful, if not intolerable, to the eye for any considerable length of time. Intense light, as the sun in clear, bright weather, as well as very bright artificial light, produce pain, and if gazed at any considerable length of time, may permanently impair or wholly destroy vision. How will be shown hereafter.

Sound is, also, one of the correlated forces, and for every sound perceived by the central nerve mass, or ganglion, there must be chemical changes, and, as in the case of vision, sound may, by its intensity, produce such structural changes in the auditory apparatus, as to permanently impair, or wholly destroy, the sense of hearing.

So, through the medium of vision, hearing and touch (in which are included taste and smell, as only modifications of the sense of touch), impressions may be made, succeeded almost instantly by syncope—partial arrest of the dynamics of the circulation—insensibility temporarily, and insanity more or less permanently, all by chemical and structural changes in the nerve masses, or nerve conductors, or both. These are usually spoken of as moral impressions; but they are, nevertheless, due to chemical and structural changes in the nerve masses; for it has been shown, that for every dynamic result, we have special apparatus, and chemical changes in the apparatus for every effect, and it would be alike unwise and unphilosophical to slur them over, or leave them out of consideration in solving the question of "How medicines produce their effects?"

How these premises are to be applied in obtaining a solution to the present inquiry, can be illustrated better than in any other way, by tracing single agents into, through and out of the system, and from the empirical facts of their effects, deduce the philosophy of their modus operandi, seeing that to produce any results at all they must in some way affect the nutrition and oxidation of its tissues.

As the first example, take chloroform by inhalation. The first particles of its invisible vapor impigning on the surfaces of the mouth or nose, makes an impression, as light in the eye, or sound in the ear, instantly conveyed all over the system by the efferent nerves; the result is an effort, almost without volition, to prevent its further introduction. The face is turned away, the hand interposed between the face and napkin from whence the vapor comes, and breathing partially suspended. This overcome, by the will of the patient, or force of the exhibitor, the vapor passes on into the lungs, mingled with air, at each inspiration. Gradually, the functions of the life of relations are suspended, until, at a certain stage, within the limits of safety, vision, hearing, sensation, and voluntary motion, are obliterated. How? In no other possible way can this condition be produced than by bringing the organic processes, on which the life of relations depend, to a stand still. The conductors between the outer world and inner nervous masses have, so to speak, been switched off—the connection between them severed. Neglecting certain precautionary measures, or pushed beyond the point of safety, the dynamics of the life of conservation, too, are brought to a stand still—the batteries or nervous masses supplying the dynamic force for carrying on the organic processes of the circulation and respiration, have ceased to operate, and the spirit of the inhaler has passed the invisible boundary that separates life from death, to that bourne from whence none have ever returned to bring back a report, and to which we are all hastening so rapidly, in one way or another. Can the modus operandi of chloroform by inhalation be other than a partial or total arrest of destructive metamorphosis in the entire dynamic apparatus of power producers and power transmitters? If at a proper time the inhalation is suspended, the vapor is expelled from the system through the same channel by which it entered, and more or less suddenly the dynamics of life come into play again; in some cases without noticeable secondary results, in others with some disagreeable evidences of the rude interruption of the workings of organic dynamics. The precise how chloroform arrests destructive metamorphosis may never be known—that it does so, is certainly true.

As a second illustration, take morphia in solution, and, by injection, pass it into the cellular tissue, beneath the cuticle. What happens? The same results in kind, but not in degree, as chloroform; and with nearly the same rapidity in certain cases, depending, to some extent, on the quantity and place of its introduction. If injected for the relief of acute pain, the wild dynamics of life are brought within limits of safety and comfort to the sufferer. It as certainly retards destructive metamorphosis, or oxidation, as chloroform arrests it. The recovery from its influence, owing to its not being volatile, as well as the mode of its introduction into the system, is extended over more time than from chloroform, for the drug itself has to be oxidized or passed out of the system through the natural channels of elimination unchanged. But if the dose has been small enough, say one-fourth to one-half of the quantity proper by the stomach, in from two to twelve, or more hours, the organic processes of life recover their normal workings.

As another example, take an agent of opposite properties, as strychnia. As it is not susceptible of volatilization, except in the form of spray, let us inject a solution beneath the cuticle, as in the case of morphia. Its operation is nearly equally as prompt as chloroform ; and what happens ? Oxidation, or destructive metamorphosis is promoted in the spinal chord, and ganglionic and plexual masses, dynamic force is liberated, and sluggish organs and muscles are supplied with power to perform their allotted offices and functions more promptly and perfectly. If the quantity injected, or otherwise exhibited, is in excess, the voluntary and involuntary muscles are thrown into violent and painful contraction. Either condition continues until the strychnia is oxidized, or otherwise passed out of the system. So energetic and powerful is this agent, when used hypodermically, that its dose, to be safe, must be counted by hundredths of a grain. If death ensues from an over dose, it is by interrupting the alternate contraction and relaxation of the muscles of respiration, and the central organ of the circulation, the heart.

In arriving at these conclusions, we can not, it is true, watch, with the material eye, each little particle of organic matter forming new compounds of lower organization and liberating force, that may never be vouchsafed to mortal vision ; but as the antecedent and consequent are both known, we feel safe in bridging over the chasm, by assuming that it is accomplished in the same or analogous manner to the play of atoms in liberating force in the magnetic telegraph.

These are, however, exceptional modes of introducing therapeutic agents into the human system, though they constitute contributions to modern scientific medicine, whose value it would be difficult to compute. They are introduced here to show that the mode of operation of therapeutic agents is mainly the same, no matter how introduced into the system. As the conditions governing the employment of remedial agents hypodermically become more generally known to the profession, this mode of administration, for certain ends—particularly for the immediate relief of pain, owing to its certainty and celerity—must come more and more into general use, until, finally, no practitioner will be without a hypodermic syringe and solution of morphia.

For most purposes, and by far the most frequent, in the future, as in the past, medicinal agents will be introduced into the system by the mouth and stomach. Here, owing to conditions, the effects are generally more slowly evolved—more time is consumed in obtaining results—not because of any difference in their mode of producing results; for it can not be too frequently impressed, that no matter how introduced, these are in the main the same.

For illustration here, the Hydrargyri Chloridum Mite is selected. Introduced into the stomach, the nervous system seems measurably indifferent to its presence; force is neither promoted or retarded by it in any considerable degree. It is, however, certainly rendered soluble in the stomach, by means not definitely known, and is taken up by the circulation and distributed over the whole system. What happens in this case? In the circulation, to the extent of its capacity in quantity, it arrests the formation of albumen, and the metamorphosis of albumen into fibrin, and converts into excrementitious matter those substances already in existence in the blood, to the extent of its chemical equivalents. It further, either of itself, or the compounds it forms with albumen and fibrin, supplies conditions for the more or less rapid disintegration of the tissues already in existence, so that the bulk of excrementitious matter in the system is largely augmented. It has, in fact, measureably arrested nutrition or constructive metamorphosis, and largely increased waste, or destructive metamorphosis, not so much, perhaps, in the nerve tissues, as in other solid structures, so that the circulation is loaded down with excrementitious matter. In the elimination, if the emunctories fail to give it exit from the body with sufficient rapidity, the soft tissues of the mouth break down as if solutions of continuity were purposely established to give exit to the effete matter. The retrograde metamorphosis, apparently no longer under the control of the dynamics of life, form abnormal compounds especially obnoxious to the special senses of smell, taste and vision. The impressions on these senses by the effects of mercurial salivation and those of the ordinary putrefactive decomposition of animal tissues, have a striking similarity. It is not my purpose to make any effort to banish calomel from the materia medica. This very view of its modus operandi makes it an especially valuable agent for the very purpose of destroying tissue in certain pathological conditions, while, at the same time, juster views of its effects will materially limit its indiscriminate exhibition in obscure, or other cases, where its effects are not needed; for, it is true, that every case of disease does not require destruction of tissue, as a requisite to a return to health. It is almost, if not quite, a pure destructive.

As another illustration, take some form of iron, say the Ferri Redactum. Introduced into the stomach, it is, or certain portions of it, rendered soluble by its chemistry, and passes into the circulation. What does it do? In the fewest words, it quickens every act of life. The iron, or its organic compound, hæmatin, in the blood, carries the life-giving oxygen to every organ and tissue, and brings back to the lungs the carbonic acid resulting from these quickened operations. Increase of red discs, the oxygen and carbonic acid carriers; increase of albumen and fibrin; increase of muscle and other tissues. Effete matters are oxidized and passed out of the body, and the utmost activity prevails in all the organs and tissues. As in the animal organic world, the presence of iron in greater or less quantities marks its highest development and activity, so in the social and physical, it plays an equally conspicuous part. It is intimately identified with civilization. Where it is most largely consumed there is the highest development of social and industrial activities, and the diminution of its consumption marks the different stages between the highest civilization and complete barbarism. Railways, telegraphs, steamships and machinery, are the results of a high degree of civilization; for without iron, these could have no existence. Therapeutically, it is an example of a pure constructive.

As further illustrations, iodine and bromine, and their compounds, with potassa, soda and ammonia, may be considered. These are readily absorbed, as they are all more or less completely soluble in water, and are active agents in promoting oxidation of effete matter; primarily, and secondarily destructive metamorphosis in the normal tissue to a certain extent, but more especially of adventitious growths, as enlargements, tumors, &c., &c., all of which possess lower vitality, or organization, than normal tissue; and hence, these sometimes disappear with surprising rapidity under the influence of the iodides and bromides.

The good effects of the bromides of potassium, sodium, &c., &c., in nervous disorders, are probably due entirely to their oxidation and elimination of excrementitious matters, or matter below the normal grade of organization in the systems of those who thus suffer. The idiosyncrasies forbidding the use of opiates, so frequently met with in urban communities, must be largely due to defective oxidation and elimination of excrementitious matter, brought about by the habits of society, to wit: highly azotized food, sedentary lives and the habitual use of tea, coffee and spirits, limiting, as these are known to do, molecular changes, particularly of the retrograde metamorphosis of tissues, and the elimination of effete matters.

But these examples need not be multiplied. The general principles illustrated by them are applicable to every therapeutic agent, or measure, of whatever kind or character. As all diseased action is a departure from the normal standard of nutrition, the modus operandi of diseased action and therapeutic agents must necessarily be antagonisms. If diseased action consists of too much, or too little force, the action of medicines for its relief must be exactly the opposite, liberating more force where it is deficient, and restraining it where it is in excess. Thus, the cardinal point of the Hahnemanic faith is shown to be an absurdity.

While the facts of nutrition and waste, and their philosophy, and that medicines must, *per se*, to have any influence whatever, interfere with them, has been definitely established, it is, nevertheless, interesting to know that each new truth evolved by experiment or philosophy, confirms them still further. Thus, the recent physiological experiments of Richardson, of London, with his ether spray, in freezing the brain, and parts of the nervous system of birds and lower animals, are followed by results precisely analogous to those of chloroform, when the whole brain was frozen. The organic processes of life are brought to a stand still in either case, dependent on the whole, or parts of the nervous system, experimented on. And herein we have the philosophy and modus operandi of Chapman's ice bag to the spine in cholera and other disease conditions. Lowering the temperature of the brain, or any part of the power producing masses of the nervous system, arrests the liberation of force to an extent precisely corresponding to the depression of temperature until the freezing point has been passed. It will be found hereafter to be a very valuable therapeutic measure. The therapeutic results reached by Chapman must be verities, though in none of his published papers, meeting my eye, has he attempted to explain its modus operandi so exactly as it is here done.

The interference of atmospheric vicissitudes with the final process of nutrition, to wit: the passage of albumen and fibrin through cell organizations (or granules, according to Beale,) into the solid textures of tissues and organs, must be very considerable, all in fact that the popular belief attributes to "*taking cold*." In this, the popular instinct and scientific deductions and experiments agree as to results, however much they may differ as to the modus operandi. The fruit germs, in the vegetable world, if subjected in their earlier stages of development or growth, to sudden changes of temperature, and other atmospheric vicissitudes, not so low as to destroy them, but near that point, are followed by fruit marked by unequal development and growth—knotty and imperfect, as horticulturists say, So in the vegetable world we have what are called tender plants, in this latitude, i. e. natives of more southern climes, domiciled with us for their fruits, flowers or foliage, that do not bear violent variations of temperature. What can this be but the interference of atmospheric changes—and in this idea is included the variable operations of the forces of nature—with the ultimate processes of cell development and nutrition? In the tropics, where sudden changes of temperature are compartively rare, the vegetable, as well as the animal kingdoms, flourish in their highest exuberance. As we go northward, one by one of these disappear, until, in the Arctic regions, nothing is left but a few lichens.

Striking as are these instances and examples from the organized world, they are still more striking and significant in the inorganic. The softest and most malleable and ductile steel is, by sudden change of temperature, rendered so hard as to be competent to impress every other substance, the diamond alone excepted, in nature.

The skill and ingenuity of man has, as yet, been unable to produce a time piece escapement to run with absolute regularity in variable temperatures, and subjected to counter motion. Adjusted chronometer balances in watches, and mercurial pendulums in clocks, still fall below absolute accuracy. Almost every other contingency can be provided against, except changes of temperature. Some years since a disk of crude iron, 9 feet in diameter, was cast in one of the foundries of this city. In filling the mould three streams of liquid metal were used. The piece was successfully cast, as the proprietors thought. When cool enough to handle, it was removed, and set up against the outside of the building, facing the South. Before mid-day, the rays of the sun falling on it directly, the disk had fallen into many pieces, with loud explosions. Each fluid stream had passed into the solid state with its own crytallization. Each proved different, and had its own rate of expansion, and hence, when the warmth of the sun influenced them, the disk separated into many pieces. The examples of these effects are so numerous, that wherever there is matter and force illustrations will be found.

The same influences produce visible and tangible effects on the exterior tissues of the human body. In warm weather the cutis is soft, elastic and smooth. As temperature goes down, it is roughened, rendered inelastic, cracks open, and shrinks in volume. Can it be possible that these results extend no further than the coverings of the body ?

When it is recollected that the gigantic commerce of the world owes its existence mainly to man's endeavors to surround himself with the all-important equal temperatures, irrespective of geographical position, such a supposition would seem to be absurd. The earth is perforated, and its hidden treasures of fuel, ores, metals, stone, marble, clay, sand and minerals, are brought to the surface, to build, light and warm his dwellings, and to construct the vast manufactories engaged in fabricating cotton, flax, silk and wool, into articles of necessity and ornament, mainly to preserve that equal temperature about his body upon which life, health and comfort is so largely dependant. The pro rata of mortality is smallest where there is least variation of temperature, no matter what the mean diurnal or annual average ; and largest where changes are sudden and variations of temperature extreme. In the winter men are clad in wool and furs, and linger about fires, in dwellings. In summer, dwellings are forsaken, and the fields and woods afford the highest physical and mental gratification.

What do these facts mean if unequal temperatures have no influence on the normal reproduction of tissues and organs? The tissues in health are examples of the highest organization in the universe. No amount of force can raise organizable matter higher. All changes, no matter how brought about, are to lower forms of organization. A very large number, if not all, of the incurable diseases with which mankind suffer, are due, taking the testimony of pathological anatomy, to the substitution of tissues of lower organization in the nervous, muscular and visceral textures, than normal. The bane of refined, as well as of advancing life, is the failure of the dynamics of the system to force food into higher states of organization than fat and fibrinous tissue,

But, unequal temperatures are but one of many causes, all tending to reproduce tissue of lower than normal standard, at the points heretofore named.

Whatever other causes operate to produce intermitting and remitting diseases, sudden and violent variations of temperature are among the most active. These appear in spring and early summer, and again in the fall, and disappear as the weather is settled into summer and winter. The interference of these variations with the ultimate passage of cells (or granules, according to Beale) into solid textures, during one part of the 24 hours, of a day and night, can hardly result in pertect and normal tissue. The layers (supposing tissue to be thus built up) are, probably, perfect and imperfect. A paroxysm of fever may be an effort of the dynamics of the system to oxidize and expel the blighted tissue. The cause continuing in activity, insures a continuance of the paroxysms. The unaided efforts of the system in the oxidation and removal of this defective tissue, has given credit to many therapeutic agents and measures for powers and results, which they do not and never can possess. A very sensitive system may set up for the oxidation and expulsion from it of this defective tissue, intermittent fever; another, more tolerant, may allow its accumulation to a certain extent, and then set up a remittent or billious fever; while, in still another, still more tolerant than the second, the accumulation may go on until a continued or typhoid fever is the result. If, on the other hand, the quantity is excessively large, the result, the cold plague or pernicious fever, the dynamics of life, as it were, stamped out, no reaction, no pexoxidation, set up for its removal, death in the first stage or rigors.

Let this hypothesis be true or false, it embraces, explains and harmonizes all the phenomena of fever. By an extension of it all fevers may be satisfactorily explained—as well as contagion and infection; indeed, it is capable of explaining very many phenomena for which no rational explanations have ever been offered.

The final act of nutrition, the passage of the liquor sanguiness, through cell organizations, to the types and forms of the solid tissues, textures and organs, may be, and not unfrequently is, interfered with, and the tissues themselves more or less permanently damaged or modified by mechanical causes, as falls, shocks by railway or other accidents, mental and moral impressions, habits of life, as opium eating, habitual drunkenness, hereditary influence, imperfect or improper nourishment, advancing life, &c. Shock by railway, falls or other accidents, may be understood, if the subsequent train of events be referred to changes in the molecular structure of the nerve masses, and, in many instances, perhaps, invisible, even to the microscopically aided eye. If the crystalline structure has been broken up by violence, death ensues speedily, as was the case with the late President Lincoln. If modified so as to impair its dynamic integrity, the progress of decline is more gradual, but none the less certain to a fatal termination; or, if only partially damaged, recovery may be partial, seldom complete. If not interfered with, recovery will be, sooner or later, complete.

Spinal pariesis, locomotive ataxy, paralysis, imbecility, opium eating, habitual intemperance, insanity, chorea and persistent neuralgia, may be understood in the same way. And, if so viewed, a great deal of unnecessary, erroneous, not to say damaging, treatment will be avoided. The effect of imperfect nourishment, coupled with moral depression, were fully shown in those confined in the Andersonville and other military prisons, during the late war.

In the failure, little by little, to reproduce in full dynamic integrity, as life advances, the normal structure of the nerve masses, we may read the fiat, that all organic life must fade and die. (Long after this was written and delivered, Dr. Gull, at the meeting of the British Association, in August, 1868, spoke of advancing life as being due to failing tissue.) So, in another class of maladies, the so-called hysterical, we may study the abnormal working of the nervous system unconnected, in many instances, with molecular changes. The dynamics of life overleap their natural bounds, and in the nature of things, must simulate all the graver forms of diseased action, depending on structural changes, because the same instruentality in both cases bring the phenomena within our comprehension.

The hypothesis of interference with organic tissue making, by the various disturbing agencies enumerated, is, indeed, so broad, as to offer understandable explanations of many hitherto unexplained phenomena in the dynamics of life.

Attention was drawn to the fact, that violent variations of temperature interfered with the formation of perfectly clear crystalline ice from water, as well as on the evolution of vegetable fruits. It is a very singular circumstance, that a vegetable drug, which can only be perfected in its evolution at a particular elevation in tropical climates, characterized by an almost absolute evenness of temperature—for the plateau of the Andes, on which alone the cinchona barks yielding the alkaloid quinia can be successfully grown—is characterized by a temperature so even as not to exceed in variation two degrees of F. thermometer between day and night, and throughout the whole year. The cinchona will grow in our latitude, but its bark will yield no quinia. This vegetable drug, which can only be grown under such an even temperature, is the absolute specific for diseases caused by the opposite extreme of violent variations of temperature. A most wonderful coincidence, as well as wonderful fact! By this we can understand the modus operandi of quinia, and in no other way. It seems to compensate, or furnishes conditions to perfect the formation of normal solid tissues, as well as the disintegration, oxidation and expulsion from the system of the debris of imperfect tissue, caused by the interference of atmospheric vicissitudes with the processes of organic tissue making.

Prof. Wood, in the days of my pupilage in the University of Pennsylvania, had a class of unclassifiable medicines, in which he placed calomel, strychnia, arsenic, &c. The classification submitted to your notice to-day, though so simple, will, it is believed, absorb the whole materia medica, past, present and future, as well as every conceivable hygienic and remedial measure. Every article and every agent employed in the treatment of diseased conditions of our fellow men, will take its place naturally, not by force, in one or the other of the classe, as they influence nutrition and oxidation. It fulfills the requirements of scientific exactness, and explains how medicines and therapeutic agents produce their effects. For it has been shown that neither medicines, therapeutic or hygienic agencies, can have any influence, other than as they promote, retard or modify the organic acts of life—nutrition and oxidation.

At all events, it will be found to simplify very much the practical application of our art at the bed side, not only in diagnosis, but in therapeutics and hygiene. Disregarding entirely the nomenclature of disease, and the classification of therapeutic agencies now taught in our schools, and literature, each case of altered nutrition or disease, when considered on its own merits, is much more readily comprehended and treated; for, says Bence Jones, where there is found deficient, or excessive oxidation, or nutrition, the latent (so to speak) powers in food and medicine, may be made to restrain here, promote there, and so bring about that equilibrium of the forces of life which constitute health. Practical medicine will be advanced toward the position it is ultimately destined to occupy, of an exact science, whose sources of error will be confined principally to the variable and uncertain character or qualities of medicines themselves. But, with the isolated alkaloids now known, as morphia, strychnia, digitaline, santonine, quinine, &c., &c., and other which chemistry will place at our command, these may be reduced to their minimum.

The time already occupied admonishes me to close, not because the subject has been exhausted, but because other interesting topics may claim attention and discussion. What has occupied my thoughts and investigations so many months, and been rewarded, to me, at least, by so many interesting and satisfactory results, may fail to impress you, as they have me, owing to my own imperfection in reproducing my mental operations in your minds. Following, as has been done, the organic processes of life, so closely, multiple sources of error have been avoided, and the conclusions arrived at have probability of truth, which they could not have from other premises.

In closing, it may be proper to reiterate, that the mode or modes by which medicines produce their effects, have been studied in this connection, as any other objects of natural history—as something tangible, and existent, and subordinate to law or laws. An effort has been made to formulate the laws governing their dynamics. The ordinary forces of the universe have been traced from their most elementary movements in inorganic matter, to their most complex correlation in the highest types of organization in the human tissues.

The life, or vital force, or forces proper, which has embarassed this inquiry for so many centuries, seems to be entirely confined to the preservation of the types and forms of organic tissues and organs, in the midst of constantly dissolving and renewing material.

The germ has been in all cases the starting point, and no effort made to go behind it; nor has any effort been made to trace the ordinary forces of nature into either the germ, or the types and forms of organic life. For, in the words of Prof. Jackson, "In the ever-enduring beauty, order and harmony of organic nature, is evidenced the existence of a dominant force, far transcending the physical forces in the higher and more exalted nature of its productions—a ray, as it were, emanating from the Divine Intelligence itself." That undue prominence has been assigned to the vital force in physical organization at all times, is evidenced by the facts, that it is easily overborne, modified and extinguished by the ordinary physical forces—else, we should have no pathological anatomy, disease and death. It should have, therefore, this subordinate position assigned to it. Every pathological lesion, every case of disease and death, are witnesses to the feebleness of the vital force, when contrasted with, or opposed, to the ordinary modes of force.

The true position of the vital force in organic nature seems to be that of ARCHITECT OF ORGANIZATION—the preserver of form with changing material; and the tendency to escape its restraints in types and forms of organization, is the sole fact why we, as physicians, are needed. In so far, then, as the ARCHITECT is superior to the LABORER, so far the vital transcends the physical in its purposes and position. "It is," again using the language of Prof. Jackson, "so to speak, the moulds in which organic elements are poured as they ascend in organization through the vegetable to the highest types of animal tissues, as well as their retrocession back to their starting point in the inorganic world." "It is only while organizable organic matter is in these moulds, stamping, as it were, in material forms, a revelation of the creative ideas of the Eternal Artificer;" and it is but a brief moment at longest that the vital force contests and directs the operations of the ordinary physical forces in ascending and descending organization.